

First record of Acaenitinae (Hymenoptera, Ichneumonidae) from South America with description of a new species and a key to the world species of *Arotes* Gravenhorst

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Abstract

A new species of Acaenitinae, *Arotes ucumari* Castillo & Sääksjärvi, **sp. n.**, is described and illustrated representing the first record of the subfamily from South America. The new species was collected from a premontane tropical rain forest in the Peruvian Andes at 1500 m. A key to the world species of *Arotes* Gravenhorst, 1829 is provided. The subspecies *Arotes albicinctus moiwanus* (Matsumura, 1912) is raised to species rank, *Arotes moiwanus* **stat. n.**

Keywords

Amazonia, *Arotes*, Neotropics, parasitoid wasp, Peru, rainforest

Introduction

The Acaenitinae is one of the most conspicuous subfamilies of Ichneumonidae (Hymenoptera). It is clearly monophyletic as defined by at least one striking synapomorphy: the very long and triangular hypopygium of the female, although less developed in some species of the *Coleocentrus* group. The subfamily was traditionally classified in two tribes, the Acaenitini and Coleocentrini (Townes 1971). However, Wahl and Gauld (1998) suggested that this classification be discontinued as Coleocentrini is paraphyletic with regard to Acaenitini.

Many acaenitines are large in size, vividly coloured and possess long ovipositors. Despite this, little is known about their biology and specimens are rare in entomological collections. Many species of the subfamily live in ancient forests and in the Neotropics have been found in highlands (Gauld 1991). Most genera occur in the Old World, whereas only five have been reported from the New World (Townes 1971; Gauld 1984, 1991). Only one of these, *Arotes* Gravenhorst, has previously been reported from the Neotropics, where two species, *A. pamiae* Gauld and *A. facialis* (Cameron) have been described from Costa Rica and Guatemala respectively (Cameron 1886; Gauld 1991). In addition, *Coleocentrus rufus* Provancher has been collected from the Cayman Islands (a single specimen in CNC). Townes and Townes (1960) suggested an Old World origin for the subfamily with a relatively recent conquest of the New World via the Bering Strait.

The aim of the present paper is to describe a new species of *Arotes* from the tropical Peruvian Andes. Also, we raise to species rank *Arotes moiwanus* stat. n. and provide a key to the world species of the genus.

Material and methods

The only known specimen of the new species is deposited in The Natural History Museum, University of San Marcos, Lima, Peru (UNSM). The specimen is currently on loan to the Zoological Museum, University of Turku, Finland (ZMUT). We searched for more Neotropical specimens of *Arotes* at the Natural History Museum, London (NHM), the Canadian National Collection of Insects, Ottawa (CNC) and the American Entomological Institute, Gainesville, Florida (AEI).

To verify the new species status of our Peruvian specimen, we examined specimens of 10 of the 15 previously described *Arotes* species in CNC and NHM and also compared it to descriptions of all the described species. We were not able to examine specimens of *A. annulicornis* Kriechbaumer, *A. flaviscutatus* Wang & Huang, *A. odontus* Uchida, *A. nigricoxis* (Förster) and *A. sugiharai* Uchida. All species except for *A. nigricoxis* have been included in the key on the basis of original descriptions, online images of Japanese specimens (Hokkaido University, <http://neosci-gw.museum.hokudai.ac.jp/html/modules/pukiwiki/641.html>), and their inclusion in previous keys, namely those of Uchida (1934), Kolarov (1997) and Sheng and Sun (2009). The presented key

is modified from the keys of Townes and Townes (1960), Gauld (1991) and Kolarov (1997).

Observations were made using Olympus SZX10 and SZ40 stereomicroscopes. Layer photos of the holotype were taken using an Olympus SZX16 with motorized focus drive attached to an Olympus E520 digital camera. Digital photos were combined by using the programmes Deep Focus 3.1 and Quick PHOTO CAMERA 2.3. Images of specimens in BMNH were taken with a Canon EOS 450D digital camera attached to a Leica MZ12 stereomicroscope and with a Canon EOS 450D with a Pentax 50 mm macro lens. Several partially focused images were combined using Helicon Focus v. 4.80 software. Digital photos at CNC were made using a Leica MZ16 stereomicroscope with motorized focus drive attached to a Leica DFC420 digital camera. Photos were combined using Leica Application Suites Montage Multifocus software. Morphological terminology and forms of description follow those of Gauld (1991).

Taxonomy

Genus *Arotes* Gravenhorst

<http://species-id.net/wiki/Arotes>

Arotes Gravenhorst, 1829: 449. Type: *Arotes albicinctus* Gravenhorst, by monotypy.

Asthenomeris Förster, 1869: 168. Type: *Asthenomeris nigricoxis* Förster, 1888, by subsequent inclusion by Schmiedeknecht, 1888. Synonymized by Townes et al., 1965.

Sphalerus Kriechbaumer, 1878: 41. Type: *Sphalerus bifasciatus* Kriechbaumer (= *albicinctus*), by monotypy.

Retanisia Cameron, 1886: 299. Type: *Retanisia facialis* Cameron, by monotypy. Synonymized by Townes and Townes, 1960.

Diagnosis. *Arotes* can be distinguished from other genera of Acaenitinae by combination of both of the following characters: hind tarsal claws with a sharp, accessory tooth near apex of claw and areolet of fore wing open with intercubitus distal to vein $2m-cu$.

Description. Moderately large wasps, mostly black, black and white or black and yellow; legs may be reddish or yellowish in part; antennae with or without white band; fore wing with or without dark spots. Mandible with dorsal tooth equal to or slightly shorter than ventral tooth; clypeus with a pre-apical transverse ridge, the apical edge with medial tubercle in most species; subocular sulcus complete; face centrally swollen, with weak transverse ridges or weak central rugose ridges, and with median vertical ridge which extends between antennae and onto frons as distinct carina; occipital carina complete dorsally. Notaulus strong, reaching posteriorly to centre of mesoscutum; scutellum flattened, laterally carinate at least at anterior end; submetapleural carinae more or less complete, not expanded anteriorly; propodeum quite long, with more or less clearly defined area superomedia; propodeal spiracle elliptical. Fore wing without areolet, intercubitus distal to $2m-cu$; vein $2m-cu$ with two well-separated bullae. All

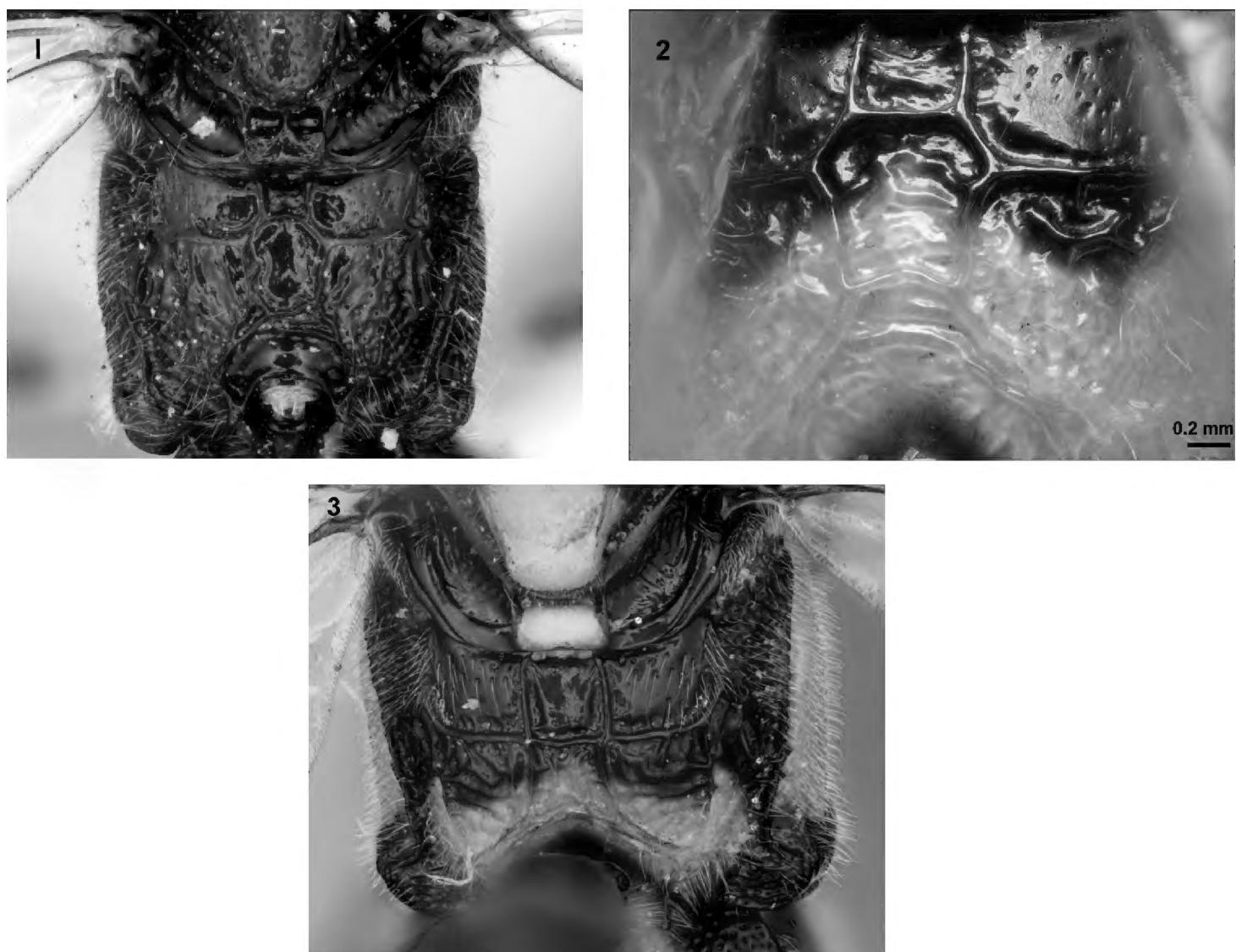
tarsal claws with sharp, accessory tooth near apex of claw. Ventral swelling of 1st sternite from acute to smoothly rounded, bearing numerous, long, erect hairs; ovipositor projecting beyond apex of metasoma by about 1.8–2.7 times length of hind tibia; ovipositor with ventral ridges apically that are vertical and widely spaced.

Key to the world species of *Arotes*

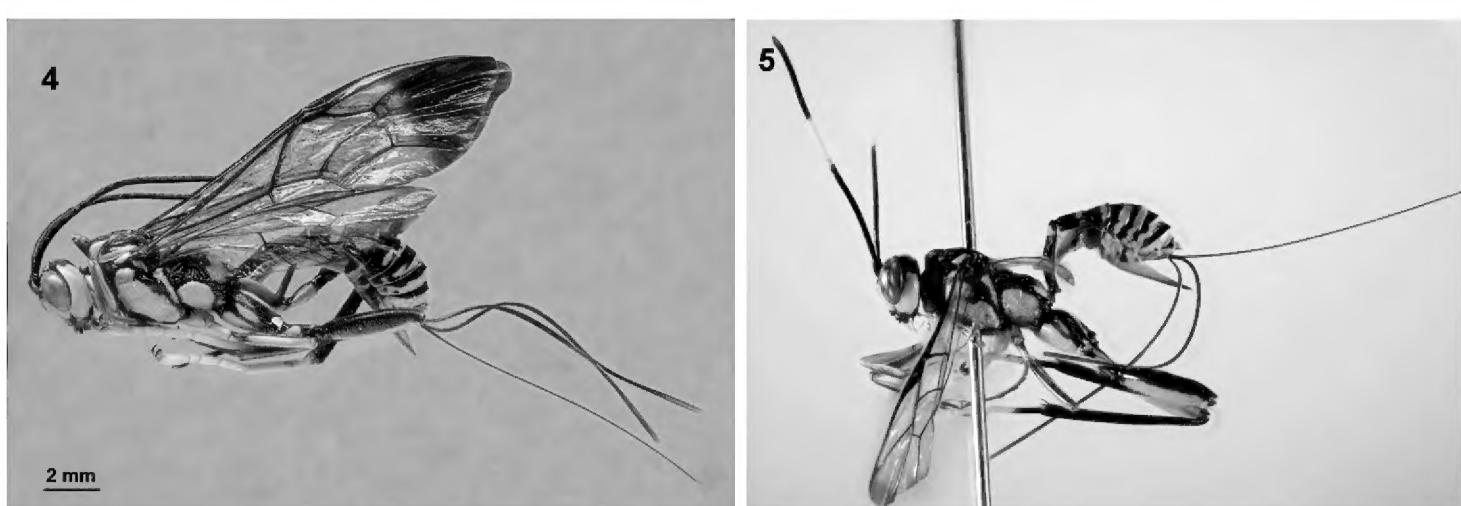
Note. *Asthenomeris nigricoxis* Förster is a species of *Arotes* according to Townes et al. (1965), but specimens of this species are not known to us and the original description (Schmiedeknecht 1888) is too brief to allow diagnosis from its congeners. For this reason it is omitted from the key below.

Specimens at CNC with intermediate colour patterns indicate that *A. albicinctus* (Gravenhorst) and *A. annulicornis* Kriechbaumer may be synonyms.

1	Propodeum completely black (Fig. 1)	2
–	Propodeum with at least some light colour (Figs 2–3)	8
2(1)	Fore wing with one or two discrete, dark spots (Figs 4–5) or, if male and spot indistinct, antennal flagellum apically broadly yellow-white.....	3
–	Fore wing lacking discrete, dark spots, at most vaguely infuscate on apical margin; male antenna not broadly yellow-white apically	7
3(2)	Fore wing with two discrete dark marks, one at apex of wing and one adjacent to pterostigma..... <i>A. sugiharai</i> Uchida (eastern Palaearctic: Japan)	
–	Fore wing with only apical dark mark	4
4(3)	Flagellum entirely dark <i>A. facialis</i> (Cameron) (Neotropical: Guatemala)	
–	Flagellum not entirely dark: lighter ventrally than dorsally and/ or with a medial light band.....	5
5(4)	Hind femur predominantly orange-red	
– <i>A. ustulatus</i> Kriechbaumer (western Palaearctic)	
–	Hind femur predominantly black or dark brown	6
6(5)	Hind tibia orange to orange-brown in basal half	
– <i>A. odontus</i> Uchida (eastern Palaearctic: Russia – Sakhalin Oblast)	
–	Hind tibia pale yellow or ivory in basal half	
– <i>A. maurus</i> Rohwer (some specimens) (western and central Nearctic)	
7(2)	First and second tergites with light-coloured posterior margins	
– <i>A. albicinctus</i> (Gravenhorst) (trans-Palaearctic and Oriental)	
–	First and second tergites completely black	
– <i>A. annulicornis</i> Kriechbaumer (western and central Palaearctic)	
8(1)	Hind tibia entirely black except may be narrowly light coloured at extreme base.....	9
–	Hind tibia broadly yellow/white at base, can be black apically, or mostly yellow or red	10



Figures 1–3. Propodeum of neotropical species of *Arotes*, posterodorsal view. **1.** *Arotes facialis*, **2.** *Arotes ucumari* sp. n., **3.** *Arotes pammae*.



Figures 4–5. Habitus, lateral view. **4.** *Arotes ucumari* sp. n., holotype female (Peru). **5.** *A. pammae*.

9(8) Antennal flagellum without white band (Fig. 4); first sternite sub-basally with smoothly rounded projection..... ***A. ucumari* sp. n.** (Neotropical: Peru)

— Antennal flagellum with white band (Fig. 5); first sternite sub-basally with acutely angled, sharp projection

..... ***A. pammae* Gauld** (Neotropical: Costa Rica)

10(8) Hind tibia completely yellow or orange, at most, slightly darker orange at apex **11**

– Hind tibia with some dark colour (black or brown) **13**

11(10) First sternite sub-basally strongly convex, like a tubercle
 *A. flaviscutatus* Wang & Huang (Oriental: China – Fujian Province)

– First sternite sub-basally weakly convex, not tuberculate **12**

12(11) Mesoscutum black or orange, sometimes with restricted lighter coloured areas, but not a continuous lighter coloured stripe along notaulus; middle of pronotum just dorsoposterior to pronotal trough almost impunctate, punctures separated by much more than their diameter
 *A. melleus* (Say) (some specimens) (central and eastern Nearctic)

– Mesoscutum black with extensive yellow or white regions, notaulus completely encompassed by a wide yellow or white stripe; middle of pronotum punctate, punctures separated by their own diameter or less
 *A. decorus* Say (southcentral and eastern Nearctic)

13(10) Mesoscutum black or orange, notaulus not completely encompassed by a wide yellow or white stripe **14**

– Mesoscutum black with extensive yellow or white regions, notaulus completely encompassed by a wide yellow or white stripe **16**

14(13) Metapleuron extensively rugose to rugoso-punctate (Fig. 6)
 *A. maurus* Rohwer (some specimens) (western and central Nearctic)

– Metapleuron finely to densely punctate without rugosity **15**

15(14) Metapleuron polished with fine punctures separated by much more than their diameter (Fig. 7); hind femur ventrally evenly narrowing subapically towards apex; female with mesoscutum ranging from completely fulvous (most specimens) to completely black
 *A. melleus* (Say) (some specimens) (central and eastern Nearctic)

– Metapleuron sub-polished with coarser punctures separated by their own diameter or less; hind femur ventrally with a strong, subapical swelling that narrows abruptly towards apex; female with mesoscutum completely black ..
 *A. moiwanus* (Matsumura) (eastern Palaearctic and Oriental)

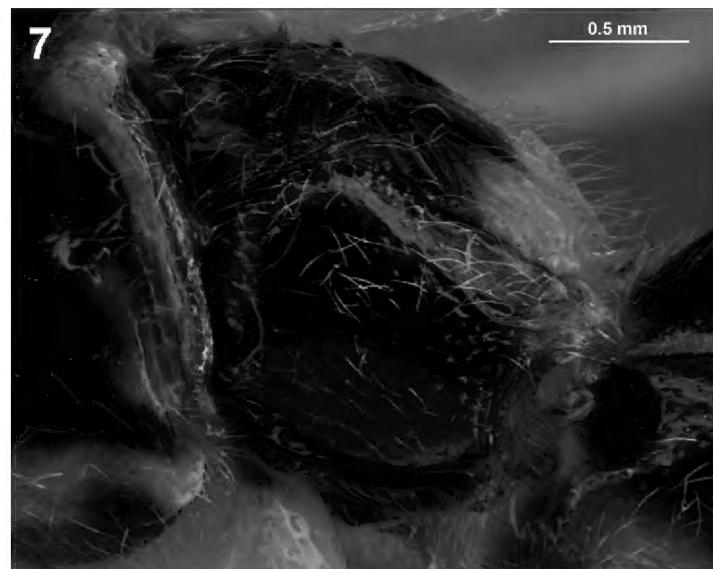
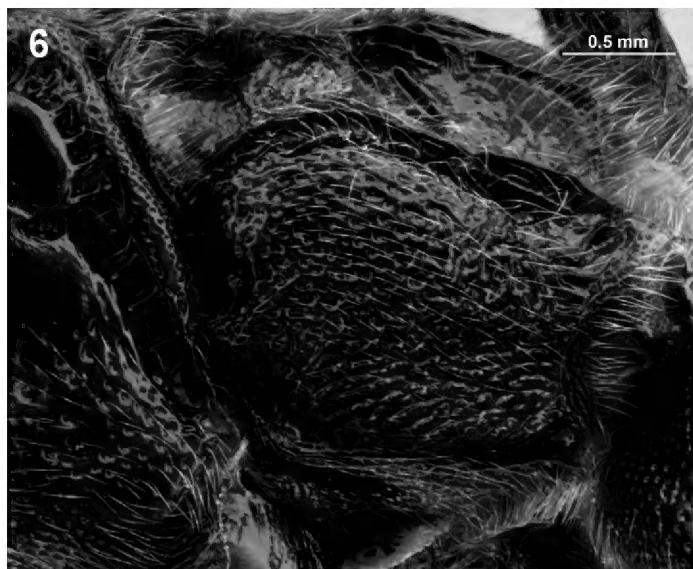
16(13) Hind tibia with at least basal 0.4 light coloured (basal 0.6 light in some specimens) *A. amoenus* Cresson (southcentral and eastern Nearctic)

– Hind tibia with no more than basal 0.2 light coloured.....
 ... *A. maculatus* Sheng & Sun (eastern Palaearctic: China – Henan Province)

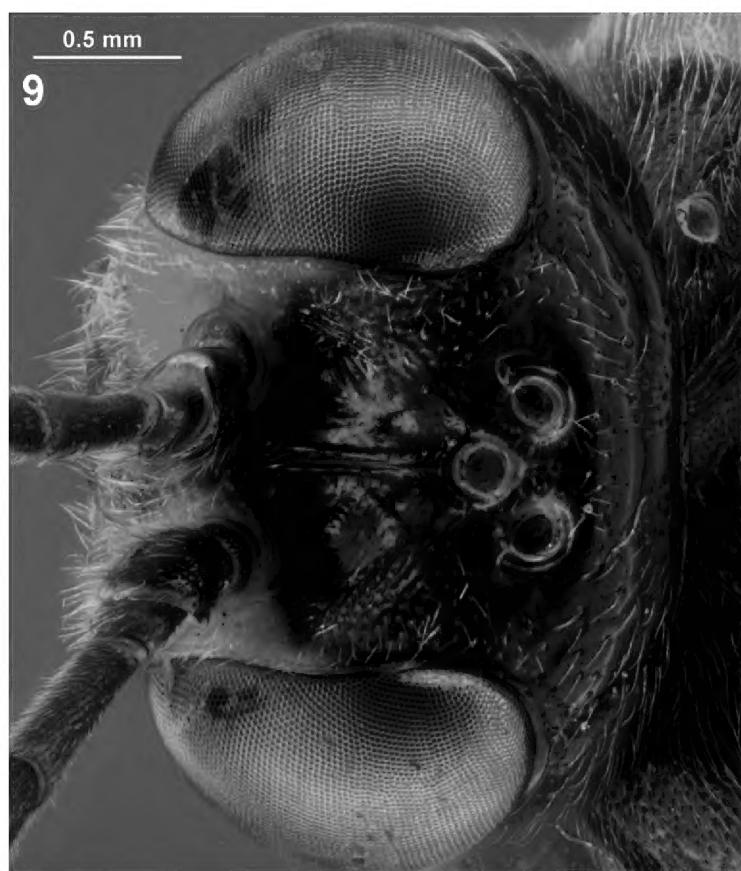
***Arotes ucumari* Castillo & Sääksjärvi, sp. n.**

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http://species-id.net/wiki/Arotes_ucumari

Type locality. Peru, Dept. of Cusco, Manu National Park, Cosñipata valley, San Pedro, 13°02'58" S, 71°32'13" W, 1500 m elev., C. Castillo leg., 20 September 2007.



Figures 6–7. Metapleuron, lateral view. **6.** *A. maurus*, **7.** *A. melleus*.



Figures 8–9. Head, dorsal view. **8.** *A. albicinctus*, **9.** *A. moiwanus*.

Type specimen. Holotype female, pinned. Original label: "Peru, CU, San Pedro, 13°02'58" S, 71°32'13" W, 1500 m, Malaise trap, 20.ix.2007, C. Castillo". UNSM.

Diagnosis. *Arotes ucumari* sp. n. (Fig. 4) can be distinguished from all other described *Arotes* spp. by combination of all the following characters: 1) hind tibia black; 2) scutellum yellow; 3) antenna without a medial light coloured band; 4) hind femur ventrally not or only slightly swollen subapically.

A. ucumari sp. n. is readily distinguished from other New World species of *Arotes* (except *A. facialis*) on account of its totally black antennae (character 3). It differs from *A. facialis* in that it has more extensive yellow colouration on the meso- and metasoma (*A. facialis* is almost completely black). In addition, the propodeal carina-

tion of the three neotropical species is different (Figs 1-3). The area superomedia of *A. facialis* is hexagonal to subcircular whereas that of *A. ucumari* is irregularly octagonal (Fig. 2). In coloration, *A. ucumari* is similar to *A. pammae* Gauld (Fig. 5) but may be separated from that species by the black antennae, smoothly rounded first sternite of metasoma and the propodeal carination (in *A. ucumari*, the anterior transverse carina joins the area superomedia at its upper half and the shape of the area superomedia is irregularly octagonal).

Description. Female. Habitus in Figure 4. Lower face broad, inner margins of eyes ventrally divergent; frons concave, smooth; antenna with 34 flagellomeres; antenna about as long as fore wing. Pronotum with striae directed to hind corner of pronotum, middle of pronotum just dorsoposterior to pronotal trough impunctate; mesoscutum with lobes sparsely, coarsely punctate, closely punctate on front side; scutellum more closely punctate than mesoscutum; mesopleurum anteriorly, ventrally coarsely punctate; metapleurum coarsely, closely punctate but, above submetapleural carina punctures are separated by more than their diameter; propodeum with area superomedia clearly delineated, almost hexagonal anteriorly, posteriorly narrowed, so that it is irregularly octagonal (Fig. 2), posterior border of area superomedia concave; anterior transverse carina joining area superomedia at its upper half; lateral longitudinal carina only delineating area externa and area posteroexterna; area petiolaris confluent with area posteroexterna. Fore wing length 14 mm, wing without areolet, with cross vein $2rs-m$ (or $3rs-m$, depending on interpretation) distal to $2m-cu$. Hind femur ventrally with a slight subapical swelling. First metasomal sternite with projection smoothly rounded; ovipositor projecting beyond apex of metasoma by about 1.9 times length of hind tibia.

Yellowish species with black marks. Head light yellow with temple, frons and inner margin of occiput black; antenna black except infuscate tip on last flagellomere. Mesosoma mostly light yellow with dorsal and hind margins of pronotum black, mesoscutum black with yellow marks on lateral and hind regions of central lobe, U-shaped mark in dorsal view, lateral sides of mesoscutum, scutellum and metanotum also yellow, hind margin of mesopleurum, mesosternum and anterior half of propodeum black. Wings slightly yellowish, with apex broadly infumate, pterostigma and veins black. Fore and mid legs with light yellow on dorsal surfaces of trochanters and femora, most of tibiae and all tarsi infuscate; hind leg black with yellow marks on lower half of coxa, two oval yellow marks on dorsal and lateral sides of coxa, most of trochanter and ventral half of femur light yellow. Metasoma black, tergites 1-2 with broad yellowish marks close to hind margin, tergite 3 almost entirely black, tergites 4+ with hind margins and lateral spots light yellow; subgenital plate infuscate with upper margin yellowish; ovipositor orange, ovipositor sheaths black with dull yellow tip.

Male. Unknown.

Biology. The host of *A. ucumari* sp. n. is not known. North American *Arotes* species have been reared from *Melandrya* (Melandryidae), *Leptura* (Cerambycidae) and *Tomoxia* (Mordellidae) (Townes and Townes 1960; Gauld 1991).

Ecology. The type locality is in a primary forest at the south east limit of Manu National Park. On the eastern slopes of the Andes, this altitude (1500 m) is considered

as a major ecotone between the humid montane forest and the premontane forest belt (Young and Leon 1999). It differs from both highland Andean and lowland Amazonian vegetation formations. The Andean foothills of Manu-Tambopata are considered to be a super-humid region (Killeen 2007). The annual precipitation in 2007, when the holotype was collected, was 3158 mm. The mean maximum and minimum temperatures were between 21,6 and 11,3 degrees Celsius (SENAMHI, National Service of Meteorology and Hydrology of Peru).

Etymology. Ucumari is the quechuan name for the only South American species of bear, *Tremarctos ornatus*, the Spectacled Bear. Just as is possible in the case of the Acaenitinae parasitoid wasps, the tremarctine bears reached the New World via the Bering Strait, and expanded their range southwards into North and South America. By naming the new species as *Arotes ucumari* we hope to draw attention to the conservation of both of these rare tropical Andean species.

The status of *Phaenolobus (Acoenitus) moiwanus* Matsumura, 1912

During the process of comparing specimens to verify the new species status of *Arotes ucumari*, examination of material of *A. albicinctus* and its subspecies *A. albicinctus moiwanus* at NHM and CNC revealed differences that could indicate that these two forms may represent two distinct species. Since Uchida (1934), *Phaenolobus (Acoenitus) moiwanus* Matsumura, 1912 has been regarded as a subspecies of *Arotes albicinctus* (Gravenhorst, 1829) (e.g. Townes et al. 1965; Yu and Horstmann 1997). Our examination found the differences listed in Table 1.

In most ichneumonid species in which subspecies are recognized, the only indicator of subspecies is colour, not sculpture. For example, *Campoplex sugiharai sugiharai* (Uchida), *C. sugiharai australis* Momoi and *C. sugiharai okinawensis* Momoi (see Momoi 1970). Such a major difference in the sculpture of the frons (striate versus sparsely punctate) generally indicates two species. We believe that the sculptural differences of the frons correlated with major colour differences of the scutellum and propodeum are clear indicators that *A. albicinctus* and *A. moiwanus* are two distinct species. *Arotes moiwanus* stat. n. is hereby recognized as a valid species. We have not seen males of *A. moiwanus* but we expect these characters to remain valid.

Discussion

Whereas description of a species based on a single specimen is not ideal, we are confident that the species is distinct based on the unique combination of characters listed in the diagnosis and our assessment of species-specific characters within the genus *Arotes*. For example, the presence of a completely black flagellum in *A. ucumari* is very rare for the genus (in the previously described species only *A. facialis* from Guatemala has this character, all other species have either a medial pale band or are lighter on the ventral surface

Table 1. Key morphological differences between *A. albicinctus* and *A. moiwanus*

<i>A. albicinctus</i>	<i>A. moiwanus</i>
Frons with strong oblique striations extending from medial ocellus towards eye. Orbit with dense, coarse punctures near antenna (Fig. 8).	Frons with weak striations or striations absent between medial ocellus and eye. Orbit with moderately fine, sparse punctures near antenna (Fig. 9).
Scutellum and propodeum black.	Scutellum and propodeum marked with light colour (creamy-white to yellow).

of the flagellum than the dorsal surface). It is highly unlikely that *A. ucumari* and *A. facialis* are conspecific because the body of *A. facialis* is almost completely black (Gauld 1991), whereas *A. ucumari* has large yellow regions on the body (Fig. 4). In addition, the area superomedia of *A. facialis* is hexagonal to subcircular (Fig. 1) compared to *A. ucumari* in which this area is much wider anteriorly than posteriorly (Fig. 2).

In our opinion, it is important to describe the new species now, rather than wait for additional material to be collected. Considering the extensive collecting done in this region, for example, the Colombian Arthropod Project (CAP) from 2001 to 2003, 188 Malaise trap months in Peru from 1998-2001 (Sääksjärvi et al. 2004) and 6 years of canopy fogging in Ecuador since 1994 (Erwin et al. 2005), it is unlikely that a great number of additional acaenitines will be rapidly collected. The description of this species will draw attention to the presence of acaenitines in South America which will hopefully lead to the discovery of additional material (both in collections and from future collecting by other individuals).

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